

8. GEOGRAPHY AND ECOLOGY OF ASTOVE

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Introduction

Astove, 10°6'S, 47°45'E, is an elevated atoll with a nearly continuous land rim, located 35 km south of Cosmoledo Atoll and 145 km south-east of Aldabra. There have been fewer visits by scientists to Astove than to many of the neighbouring islands, and older records are particularly scarce. Fryer called there briefly in 1908 (Fryer 1911), following Dupont in 1906 (Dupont 1907). The main accounts are those by Vesey-FitzGerald (1942), Baker (1963), and Piggott (1961a, 1961b, 1968). Table 8 lists scientific visitors to Astove. This account is based on the literature, and on observations made during two visits by Royal Society Expedition personnel, the first by ten members on 5 March and the second by five on 14 September 1968. Most of these observations were made on the western side of the atoll, though some members visited the northern part of the east side, and Stoddart walked round the whole land rim. The first hydrographic survey of Astove was by H.M.S. Owen in 1964 (Admiralty Chart 718, 1967); Figure 5 is based on small-scale aerial photography carried out in 1960, with details added from Baker (1963) and Piggott (1961b, 1968).

Geomorphology

Astove has maximum surface dimensions of 4.6 x 2.8 km: the land area is 4.25 sq km, that of the lagoon 5 sq km, and the total, including peripheral reef, about 9.5 sq km. It stands on the southernmost of two presumably volcanic peaks which rise from the ocean floor at depths of 4000-4400 m; Cosmoledo stands on the adjacent peak to the north. The atoll lagoon is very shallow, with large areas less than 0.5 m, and it has a restricted tidal range. According to the lessee, the lagoon level gradually falls in the two weeks preceding neaps until a large part of the floor is exposed. Between neap and spring tides the level rises. Thus flow into the lagoon is greater than out of it during spring tides, and vice versa during neaps. The diurnal cycle is damped within the lagoon. The lagoon entrance at the south point is approximately 100 m wide, and also shallow.

Much of the west rim of Astove is formed of elevated reef-rock, which rises to 4-5 m above sea level. In the north the reef-rock is fairly smooth and partly covered with sand, but further south it is

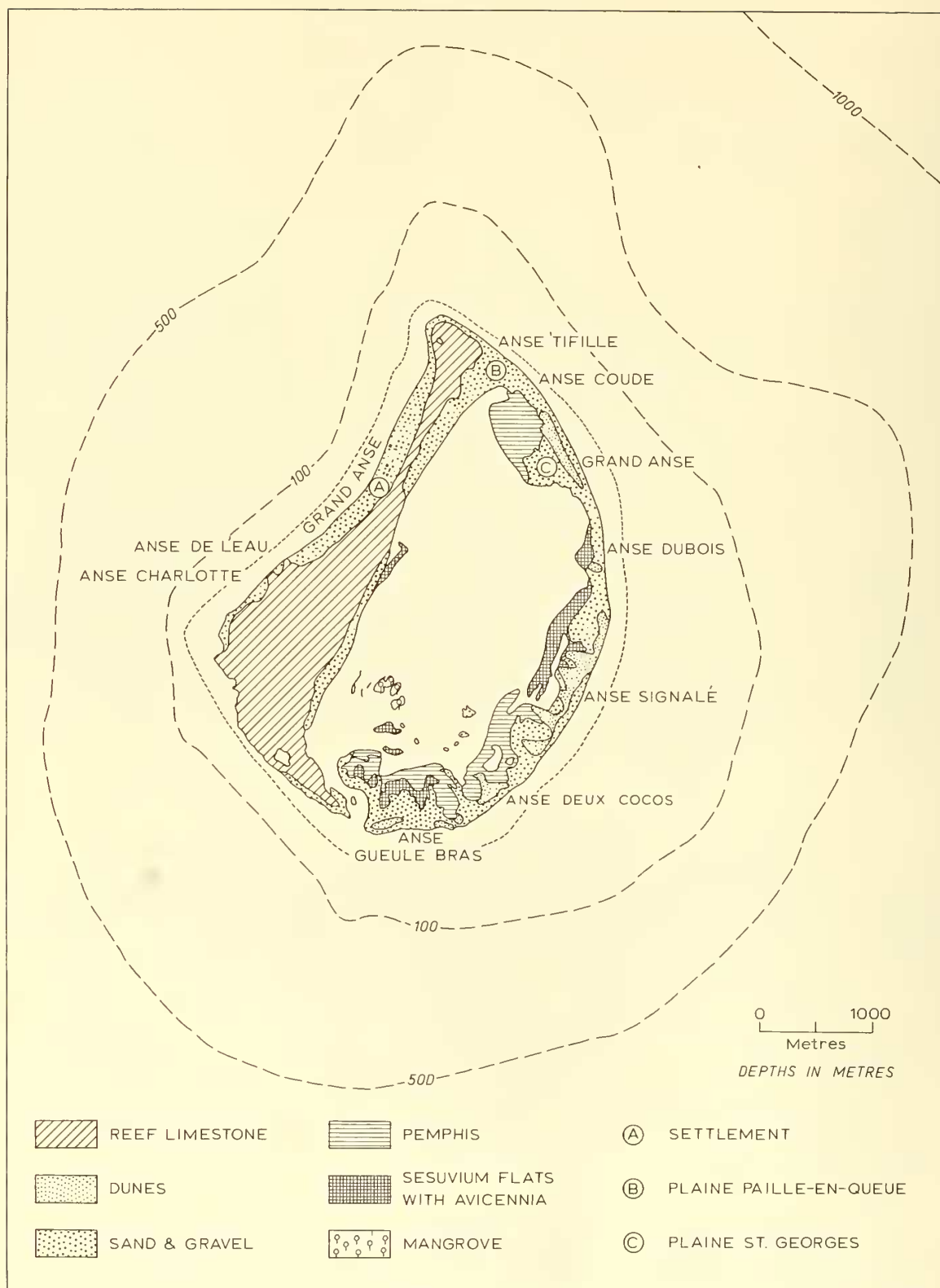


Fig. 5. Astove

Table 8. Scientific Studies at Astove

<u>Date</u>	<u>Study</u>	<u>Reference</u>
1895	S. C. E. Baty, agricultural survey and rudimentary chart	Bergne (1900); Adm.Ch.718(1911)
1901	H. A'C. Bergne, general observations	Bergne (1901)
1906 Sept.10-14	R. Dupont, fauna, flora, agricultural potential	Dupont (1907)
1907	H. L. Thomasset, insects	
1908 Aug.28-Sept.1	J. C. F. Fryer, insects, general observations	Fryer (1908, 1911, 1912); Gardiner (1936)
1910*	R. Dupont, insects, plants	
1937 Oct.	L. D. E. F. Vesey-FitzGerald, vegetation and birds	Vesey-FitzGerald (1940,1941,1942)
1952 Nov.	E. S. Brown, insects	
1956	W. Travis, underwater and general observations	Travis (1959)
1957 Dec.9	W. D. Hartman, land birds	Hartman (1958)
1960 Oct. 6-9	B. H. Baker, C. J. Piggott, geology and soils	Baker (1963); Piggott (1961a, 1961b, 1968)
1964 March 16	H.M.S. Owen, Cmdr D. W. Haslam: survey, birds	Bourne (1966)
1964	R. E. Honegger, reptiles	Honegger (1966)
1967 March 8	J. F. G. Lionnet, H. A. Beamish, insects	Lionnet (1970)
1967 Oct. 7	M. D. Gwynne, D. Wood, I. S. C. Parker, collections of plants and birds	Parker (1970); Gwynne and Wood (1969)
1967-8	Mrs R. M. Veevers-Carter and Miss T. Ridgway, collection of plants	Fosberg and Renvoize (1970)
1968 March 5	C. W. Benson, B. H. Cogan, A. W. Diamond, F. R. Fosberg, J. Frazier, A. Graham, P. Grubb, A. Hutson, K. McKenzie, S. A. Renvoize	This report
1968 Sept. 15	C. J. Bayne, J. C. Gamble, M. E. D. Poore, D. R. Stoddart, T. S. Westoll	This report
1969 June	A. W. Diamond, J. Frazier	This report

* J. A. de Gaye collected Lepidoptera, now in the Rothschild Collection, British Museum (Natural History), on Astove at a date unknown, probably c. 1910.

deeply dissected with large solution holes and is comparable to some of the more extreme Aldabra champignon. The reef-rock is known on Astove as pavé, a name which might be adopted for smoother-surfaced raised limestone which is more irregular than Aldabra platin and stands at a higher level. Baker (1963, 92-97), who calculates the area of raised reef-rock to be 236 ha or nearly 50 per cent of the total land area, has noted that the solution holes are arranged in straight lines in the reef-rock surface.

The reef-rock outcrops to form low cliffs along the southwest coast, but further north there is a seaward sand strip up to 500 m wide (forming Grand Anse) between the sea and the raised limestone. There is also a discontinuous sand strip on the lagoon side of the limestone: it is more complete in the north, where there are vegetated dunes 5-6 m high.

The eastern rim of Astove consists of low sand and gravel spreads overtopped on the seaward coast by active dunes up to 18 m high. These are highest and steepest in the north and become progressively lower and smaller southwards. There is no raised reef-rock outcropping on the surface of the east rim. Much of the seaward coast is rocky, however, though with the appearance of a massive bedded beach conglomerate, with seaward dip, rather than a raised reef-rock. This is a rough-water coast during the Southeast Trades, and because of the narrowness of the reef platform the beaches are formed by gravel, cobbles and rubble as well as sand. Patches of horizontally-bedded sandstone outcrop in places along the lagoon shore, but these may be of recent origin exposed only by the enlargement of the lagoon, and hence do not necessarily result from uplift.

The northern area linking the east and west rims, Plaine Paille-en-Queue, is a largely unvegetated gravel fan that appears to have been recently deposited. It may be either a recent channel fill in a depression formerly separating the two rims, or a cyclone deposit. It is surmounted along the seaward coast by a low sandy beach.

The fringing reef surrounding the land rim is narrow, with an average width of 250 m. On the east side it is an erosional feature, with potholes and deep grooves normal to the shore. The reef front is exceptionally steep, especially on the west side, where the bottom plunges so steeply that ships are unable to anchor and a cable must be taken inshore by small boat and an anchor lodged on the reef flat. A buoy formerly moored outside the reef near the settlement has been washed away.

Fryer (1911) considered that the raised reef-rock indicated a relative uplift of Astove by at least 18 m. The asymmetry of the atoll is striking, with reef-rock confined to the western side, with its straight, vertical (faulted?) coast, and absent from the east side. This suggests tilting rather than simple eustatic emergence of the atoll rim; the asymmetry is also evident in the 100 and 500 m isobaths (Figure 5). No evidence has yet been seen on Astove either of an 8 m ridge or

of a newer limestone at the 4 m level, as on Aldabra, but observations have been rapid and the reef-rock areas have been much altered by phosphate mining in the past.

The usual soil series have been distinguished by Piggott (1961): Desnoeufts Series on the limestone, now largely removed for phosphate; Farquhar Series on the dunes; and a variable Shioya Series, including gravelly loamy sand and loamy sand.

Vegetation

Previous workers have recorded 58 species of flowering plants from Astove (Dupont 1907, Vesey-FitzGerald 1942). Recent collections have been made by Gwynne and Wood (1969) in 1967, by Veevers-Carter and Ridgway in 1967-68, by Fosberg and Renvoize in March 1968, and by Stoddart and Poore in September 1968. These collections are listed in the following paper (Fosberg and Renvoize 1970). The flora resembles that of Aldabra, though the area of sand is much greater, and there has been more interference by man. The following vegetation types can be distinguished:

1. Pemphis hedge on leeward cliffs.
2. Scaevola hedge on leeward sand beach.
3. Mixed scrub on raised reef-rock.
4. Coconut woodland on leeward sand plains.
5. Coconut woodland on leeward stable dunes.
6. Casuarina woodland on the western rim.
7. Lagoon beach scrub of Scaevola and Pemphis.
8. Scrub of Suriana maritima on high dunes, with ground cover of Fimbristylis cymosa, and with scrub of Tournefortia and Scaevola in protected situations.
9. Grasslands of the exposed sand and gravel plains of the north and east sides.
10. Sesuvium mat of the eastern lagoon shore, with occasional Avicennia.
11. Dwarf mangrove woodland of lagoon islets.

The characteristics of these types can best be described in terms of their distribution round the atoll rim.

West rim

The raised limestone vegetation is similar to that of Aldabra, but more open. Thespesia populneoides (3 m) and Grewia salicifolia are the only common trees, and Pisonia grandis, Euphorbia abbotti and Sideroxylon inerme, all previously recorded, were not seen. The most common shrubs are Vernonia aldabrensis (1-2 m), Colubrina asiatica (2-3 m), Azima tetracantha and Gagnebina pterocarpa. Other characteristic plants are Capparis cartilaginea, Lomatophyllum borbonicum, Cassia occidentalis and Euphorbia hirta. North of the settlement the limestone outcrop is narrower, with fewer and smaller shrubs (mainly Vernonia aldabrensis and Colubrina asiatica) and with a ground cover of Ipomoea tuba, Cassytha filiformis, Plumbago aphylla, Sarcostemma viminale, Launaea intybacea, Boerhavia elegans, Asystasia bojeriana and Vernonia cinerea. This

resembles the vegetation of the more disturbed areas on the limestone near the West Island settlement on Aldabra.

The sand strip south of the raised reef-rock has a seaward hedge of Pemphis acidula 3-4 m tall, then a low dune area under woodland of Cocos and Casuarina. Cordia subcordata is common in the lee of the Pemphis hedge. The ground cover in the woodland consists of grasses (Dactyloctenium aegyptium, Enteropogon sechellensis, Cenchrus echinatus), with Cassytha, Vernonia cinerea and other plants. Gossypium hirsutum, Caesalpinia, and Ricinus communis are common under the coconuts and in the more open areas. There is a large ornamental tree of Tabebuia pallida at a small fishermen's hut in this section.

Further north the lagoonward sand strip has a discontinuous hedge of Suriana maritima and Pemphis acidula, with a woodland of Cocos and Casuarina on low hummocky dunes. Guettarda speciosa is quite common, Tournefortia argentea much less so. The woodland has a low tree storey of Guettarda, and a ground layer of long vines of Ipomoea pes-caprae and I. tuba, with Digitaria horizontalis, Fimbristylis cymosa, Boerhavia repens and Stachytarpheta jamaicensis.

The seaward sand area on the west rim has a littoral hedge of Suriana maritima and Scaevola, with Guettarda; Tournefortia is again uncommon. The coconut woodland is mostly 5-10 m tall, with some Guettarda and Vernonia beneath, but generally there is no shrub layer and only a ground cover of grasses, sedges, vines and herbs. This carpet includes Dactyloctenium aegyptium, Cenchrus echinatus, Sporobolus virginicus, Stachytarpheta jamaicensis, Euphorbia prostrata, Sida parvifolia, Boerhavia, Ipomoea tuba, Achyranthes aspera and Fimbristylis cymosa. Immediately south of the settlement the coconut woodland has a layer of scattered shrubs, with Maytenus, Barleria sp., Grewia salicifolia and Vernonia aldabrensis as well as low trees of Guettarda.

At the settlement there is a grove of tall Casuarina trees, a single Hernandia, and common introduced plants. Catharanthus roseus and Ipomoea pes-caprae are plentiful round the houses, and Agave is cultivated.

East rim

The vegetation of the east rim differs markedly from that of the west, largely in the almost complete absence of trees, except for some small chlorotic coconuts on Plaine St George, in the lee of the highest dunes, but also in the absence of raised limestone and its characteristic plants.

The high northern dunes are covered on their seaward side with a dense scrub of Suriana maritima, overgrown with Cassytha. Bare areas, especially on the tops of the dunes, have clumps of Fimbristylis cymosa, Euphorbia sp., and Boerhavia; and immediately in the lee there is less

luxuriant Suriana, with Scaevola and Tournefortia on more protected sites, and a ground cover of Fimbristylis cymosa and Sporobolus, with Portulaca oleracea, Euphorbia sp., and Sida parvifolia. The gravel and sand plains lack not only trees but also shrubs: the gravel spreads are covered with mats of Plumbago aphylla and Cassytha filiformis, the sand with Dactyloctenium aegyptium, Eragrostis sp. cf. riparia, Sporobolus virginicus, Fimbristylis cymosa, Cleome strigosa, Stachytarpheta jamaicensis and Ipomoea tuba. Much of this ground is burnt over frequently.

The lagoon shore is fringed with a low (1-2 m) scrub of Pemphis acidula or Suriana maritima, which is very difficult to penetrate, and much of which is dead. On the lagoonward side of the Pemphis there is normally a zone of bare silty sand, then a belt of fleshy Sesuvium portulacastrum, extending along most of the lagoon shore, forming a mat up to 80 m wide. There are very occasional stunted trees of Avicennia marina up to 2 m tall in this Sesuvium zone.

The islets near the south end of the lagoon support a dwarf mangrove woodland (1-1.5 m high) of Lumnitzera racemosa and Rhizophora mucronata, the former on the windward eroding shores, the latter (more rarely) on higher drier areas. Suriana and Pemphis are both present on these islets.

The northern gravel spread of Plaine Paille-en-Queue has a very sparse vegetation cover, with a line of windbreak Casuarina at its west end, and a mosaic of Stachytarpheta, Achyranthes, Boerhavia, Plumbago, Dactyloctenium and Fimbristylis. Cassytha is widespread. Pemphis acidula forms a hedge along the lagoon shore.

Fauna other than Birds

Small faunal collections were made by Fryer in 1908: in addition to insects, he collected two spiders (Hirst 1911) and two reptiles (Boulenger 1911). Honegger (1966) collected reptiles more recently, and Legrand (1965) and Lionnet (1970) the Lepidoptera. Further collections were made by the Royal Society party in March 1968.

The littoral fauna and flora resemble those at Aldabra. On the west rim, near the Settlement, the reef flat is sandy and covered with marine grasses, of which Cymodocea predominates toward the seaward edge. Low overhanging cliffs to the north have a fauna which includes the snails Nerita plicata and Nerita undata, the large chiton Acanthopleura brevispinosa, the limpet Cellana cernica, a red xanthid rock crab, and the grapsid Grapsus tenuicrustatus. Echinometra matthai was also collected on the flat. On the east coast, near the high dunes, the cliff is formed by a rough champignon sloping down to an abrasional flat. The cliff lacks the pinnacles and pools of similar cliffs at Cinq Cases, Aldabra, and there is no spray fauna such as that associated with Cinq Cases rock pools. Grapsus tenuicrustatus, Coenobita rugosa and C. perlatus were observed here. Round the lagoon shore there are

wide muddy flats. In the north there are abundant Uca holes in the mud, as well as numerous large elliptical holes occupied by the giant portunid crab Scylla serrata. On the lagoon shore there are many mollusc shells, both of bivalves and Cerithium. Table 9 lists the marine mollusca and Table 10 the Decapod Crustacea collected by P. Grubb in 1968, and identified by J. D. Taylor.

Astove is an important nesting ground for Green Turtle, Chelonia mydas, though on a smaller scale than formerly: Baty in 1895 was told of 150 being taken in a single 24 hour period (Bergne 1900). Hirth (FAO 1967) considers that Astove has the largest Green Turtle rookery in the Aldabra group, though he gives no evidence for this. Hawksbill turtle are said to be rare.

Of the land fauna, Rothschild (1915) records the former existence of the Giant Land Tortoise Geochelone gigantea, now extinct, and Fryer (1911) records the finding of remains in the raised limestone. No historical records of its presence on Astove are known. Three other reptiles are found: Phelsuma astricta astovei FitzSimons (Mertens 1962), a brightly coloured form; Hemidactylus mercatorius (Honegger 1966); and Ablepharus boutonii. All were seen in 1968 in the settlement area, and Ablepharus was also seen on lagoon islets. All three genera are common on southwest Indian Ocean coral islands. Among the land Crustacea, Birgus latro and Cardisoma carnifex are conspicuous.

Table 11 keys the literature on the small recorded insect fauna of Astove found in the Percy Sladen Expedition reports. Collections made by Cogan and Hutson in 1968 will probably increase the known insect fauna from less than 30 to more than 100 species, in spite of only about six hours collecting. The vegetation on Astove, like that on Cosmoledo, is more luxuriant than on Aldabra, and this is reflected in the insect population. This shows a great variety of form, including many of the species found on Aldabra and Cosmoledo, with one or two striking additions. The large dark brown Hemipteran Anoplocnemis curvipes (Fab.) was particularly noticeable, and although this species has been taken in Aldabra in the past it has not been found there during the present expedition. The composition of the insect fauna appears to be very similar to that of the other islands in the Aldabra group. It consists of a large Ethiopian element with strong Malagasy connections, the remainder consisting of cosmotropical species together with a small number of endemics. These generalisations are based on previously recorded material and a preliminary survey of the 1968 material. So far the 1968 collections have been found to include one Dolichopodid fly of the genus Sciapus endemic to Astove, and a probable new subspecies of the Pierid butterfly Colotis evanthides Holl.

Astove is noted for its Lepidoptera (see also the subsequent paper by Lionnet, 1970), but this is not the result of a very rich fauna, but of favourable conditions for the presence of very large numbers of certain species, such as Acraea ranavalona Boisd. and Junonia clelia epiclelia Boisd. Another Junonia, J. rhadama Boisd., a brilliant blue

Table 9. Mollusca collected on Astove, 1968

Gastropoda

Trochus flammulatus Lamarck	Bursa granularis Röding
Tectus mauritianus (Gould)	Tonna perdix (Linnaeus)
Turbo argyrostomus Linnaeus	Quimalea pomum (Linnaeus)
Nerita albicilla Linnaeus	Drupa margariticola (Broderip)
Nerita plicata Linnaeus	Morula granulata (Duclos)
Nerita polita Linnaeus	Nassa francolina (Bruguière)
Nerita textilis Dillwyn	Engina mendicaria (Linnaeus)
Nerita undata Linnaeus	Nassarius grandiosa (Hinds)
Phasianella aethiopica	Nassarius muricatus (Quoy and Gaim.)
Philippi	Latirus craticulatus (Lamarck)
Philippia hybrida (Linnaeus)	Peristernia nassatula (Lamarck)
Cerithium articulatum Adams	Cantharus undosus (Linnaeus)
and Reeve	Mitra stictica (Link)
Cerithium columna Sowerby	Strigatella litterata (Lamarck)
Cerithium echinatum Lamarck	Chrysame fraga (Quoy and Giamard)
Hipponyx conica Schumacher	Pterygia nucea (Gmelin)
Strombus gibberulus Linnaeus	Vasum turbinellus (Linnaeus)
Strombus mutabilis Swainson	Conus arenatus Hwass
Polynices melanostoma (Gmelin)	Conus coronatus Gmelin
Cypraea annulus Linnaeus	Conus ebraeus Linnaeus
Cypraea carneola Linnaeus	Conus flavians Lamarck
Cypraea erosa Linnaeus	Conus pulicarius Hwass
Cypraea helvola Linnaeus	Conus rattus Hwass
Cypraea histrio Gmelin	Terebra affinis Gray
Cypraea isabella Linnaeus	
Cypraea lynx Linnaeus	<u>Bivalvia</u>
Cypraea moneta Linnaeus	
Cypraea vitellus Linnaeus	Modiolus auriculatus Krauss
Phalium achatina Lamarck	Septifer bilocularis (Linnaeus)
Cymatium nicobaricum (Röding)	Gafrarium pectinatum (Linnaeus)
Cymatium pileane (Linnaeus)	

Collected by P. Grubb; identified by J. D. Taylor; incorporated into the collections of the British Museum (Natural History), accession number 2214.

Table 10. Crustacea (Decapoda) collected on Astove, 1968

<i>Grapsus tenuicrustatus</i> (Herbst):	2♀ 1♂
<i>Metopograpsus messor</i> (Forskål):	2♀ ovig.
<i>Pachygrapsus polyodus</i> (Stebbing):	1♂
<i>Percnon guinotae</i> Crosnier:	1♂
<i>Thalamita prymna</i> (Herbst):	1♂
<i>Charybdis orientalis</i> (Dana):	2♀ ovig.
<i>Actaea ruppelli</i> (Krauss)	
<i>Chlorodiella niger</i> (Forskål):	1♂
<i>Phymodius monticulosus</i> (Milne Edwards)	
<i>Phymodius unguatus</i> (Milne Edwards):	2♂
<i>Epixanthus frontalis</i> (Milne Edwards):	1♂ 3♀
<i>Xanthias lamarckii</i> (Milne Edwards):	2♂
<i>Liomera monticulosus</i> (Milne Edwards):	1♂
<i>Lachnopodus subacutus</i> (Stimpson):	1♀
<i>Atergatis floridus</i> (Linnaeus):	2♂
<i>Zozimus aeneus</i> (Linnaeus):	1♀
<i>Eriphia laevimanus</i> (Guérin):	1♀
<i>Eriphia scabacula</i> (Dana):	1♀
<i>Lybia tessellata</i> (Latreille):	1♂ 1♀
<i>Madaens granulatus</i> (Haswell):	1♀
<i>Coenobita perlatus</i> (Milne Edwards):	1♀
<i>Coenobita rugosus</i> (Milne Edwards)	
<i>Pagurus megistos</i> (Herbst):	1
<i>Pagurus pedunculatus</i> (Herbst):	3
<i>Calcinus elegans</i> (Milne Edwards):	2
<i>Calcinus laevimanus</i> (Randall)	
<i>Clibanarius striolatus</i> (Dana)	
<i>Clibanarius virescens</i> (Krauss)	

Collected by P. Grubb; identified by J. D. Taylor; incorporated into the collections of the British Museum (Natural History).

Table 11. Insects recorded from Astove by the Percy Sladen Expedition

<u>Group</u>	<u>Number of species</u>	<u>Reference</u>
Orthoptera	2	Bolivar (1912, 1924)
Hemiptera	2	Green (1907), Distant (1913), Mamet (1943).
Lepidoptera	5	Fryer (1912)
Coleoptera	7	Champion (1914), Gebien (1922), Schenkling (1922), Scott (1912)
Hymenoptera	6	Burr (1910), Turner (1911)
Diptera	2	Lamb (1912)

Nymphalid, is found on Astove, presumably colonising from Malagasy, but it has progressed no further in the Aldabra group. Unfortunately it appears to be decreasing in numbers and was not seen by the 1968 party. Fryer in 1908 found it not uncommon along the lagoon shore (Fryer 1912).

Another less pleasant part of the insect fauna, very much in evidence, is the mosquito Aedes (Ochlerotatus) fryeri Theo., found in very large numbers. This species breeds in brackish and salt water in the crab-holes along the shore, and the human inhabitants must often sit in clouds of smoke for protection in the evenings.

Birds

The land bird fauna is small and very similar to that of Cosmoledo; it is considered in detail by Benson (1970) in a later paper. Of the six probably resident land birds, two (Dryolimnas cuvieri, Streptopelia picturata) have not been recorded since 1906 and 1908 respectively (Dupont 1907, Fryer 1911) and are certainly extinct. Corvus albus is present in very small numbers. Cisticola cherina is the most abundant land bird, followed by Nectarinia sovimanga; the white-eye Zosterops maderaspatana is not common. In addition to these land birds considered by Benson, Stoddart was informed that pigeons inhabited a large bird box in a tall Casuarina at the settlement, but he did not see the birds, which may have been recently introduced. Benson lists four shore birds as possibly resident: Ardea cinerea, Egretta garzetta, Bubulcus ibis and Butorides striatus. Adults and young of Ardea cinerea were seen in June 1969 by Frazier and Diamond.

The sea bird fauna is unusually impoverished, presumably as a result of the lack of suitable habitat for tree-nesting birds (the absence of mangroves, for example), the degree of human interference, and the continuity of the land rim and resulting lack of isolated refugia. Sea birds have been recorded by Dupont (1907), Vesey-FitzGerald (1941), and Bourne (1966). Diamond made observations on the western rim briefly in March 1968. The only sea birds seen were one or two adult Caspian Terns Hydroprogne caspia and three Crested Terns Thalasseus bergii. The site of a small colony of terns, probably Sooty Terns Sterna fuscata, was found on the islet Petit Astove off the western extremity of the atoll. Frazier saw the Caspian Tern in the lagoon on the same occasion, and Stoddart two of the same species on the eastern rim in September 1968. Frazier also saw the Crested Tern over the lagoon in March.

Previous records are scanty, and often refer to the Aldabra archipelago generally rather than to Astove itself. They may be summarised as follows:

Phaethon lepturus

Recorded from the archipelago by Watson et al. (1963).

Sula sula

Recorded by Watson et al. (1963) as "formerly" occurring. Seen on the west side by Hartman (1958) and by H.M.S. Owen (Bourne 1966).

Fregata arielFregata minor

Both species recorded generally in the archipelago by Dupont (1907).

Hydroprogne caspia

Seen in March by Diamond and Frazier on the west side and in the lagoon; in September by Stoddart on the east side; and in October by Vesey-FitzGerald (1941, 527). Young seen with adults in June 1969 by Frazier and Diamond.

Sterna fuscata?

Colony probably of this species on Petit Astove, noted by Diamond.

Sterna albifrons

Recorded by Dupont (1907), as S. minuta.

Thalasseus bergii

Recorded by Bourne (1966); three seen by Diamond. Young seen with adults in June 1969 by Frazier and Diamond.

Gygis alba

Recorded by Dupont (1907).

Seychellois labourers on Aldabra, who were familiar with Astove, said that both "Diamant" (a Creole term covering three species of tern but here most likely to be the Black-naped Tern Sterna sumatrana) and Audubon's Shearwater Puffinus l'herminieri nest on Astove. Even if this were confirmed, Astove would still have the most impoverished sea bird avifauna in the archipelago. In addition to the lack of trees for nesting of such species as Fregata spp., Sula sula and Gygis alba, there are very few of the small islets favoured by Noddy Terns Anous stolidus, Black-naped and Crested Terns, Sterna sumatrana and Thalasseus bergii and Yellow-billed and Red-tailed Tropic Birds Phaethon lepturus and P. rubricauda.

Settlement

Little is known of the early history of Astove. A Portuguese slaver Don Royal is said to have been wrecked there, probably in the eighteenth century, and the survivors to have lived on the atoll for 30-40 years. Other vessels were certainly wrecked, and the remains of some can still be found on the western reefs. Two old graves formerly existed on the west shore. At the time of Sebert Baty's survey in 1895 (Bergne 1900), the atoll was uninhabited, and there were only six coconut palms on the entire island, one of them at the landing place on the west side.

In that year James Spurs left four men there for fishing and built a hut 100 m south of the palm tree on the west shore. Because of lack of rain for six months, water had to be landed for these first settlers. Bergne (1901) found the settlement deserted six years later and the buildings destroyed. Though Baty had forecast that maize would probably be a failure, 150 acres (60 ha) had been cleared for this crop by 1901, a few hundred coconuts had been planted, and tomatoes and pumpkins had been cultivated. Five labourers were left there, and Fryer (1908) found gourds, pumpkins, water melons, maize and tobacco to be cultivated.

No details have been traced of the progress of the guano mining industry on the atoll. According to Baker (1963, 92-97), 72,162 tons of guano were exported between 1927 and 1960, leaving reserves (Baker 1963, 124) of less than 5,000 tons. Baker's analyses of the guano gave a phosphate (total P_2O_5) content of 25-29 per cent.

By 1960 (Piggott 1961) 100 ha were planted to coconut palms, but the yield (15 tons per annum or 7 nuts per tree per year) was very poor, presumably as a result of low rainfall, cyclones, or poor management. Piggott states that the maximum area possible for coconut growing is 240 ha. Since Piggott's survey the lease has changed hands, and the present lessee, Mr R. M. Veevers-Carter, is vigorously developing the plantations with the aid of a tractor and small labour force. Maize has long been grown on the low stable dunes in the wet season. Other crops include sisal, cotton, sweet potatoes. Baty in 1895 had found numerous rats but no goats. Chickens and pigs were introduced at an early stage, and the present lessee has introduced turkeys, ducks and cattle. Giant Tortoises have been introduced from Aldabra, and the lessee hopes to introduce many other animals, and to establish a turtle hatchery. He is at present building a large new house south of the present landing point.

Between 1814, when the administration of Mauritius passed from the French to the English, and 1903, when the new colony of Seychelles was formed, Astove was administered from Mauritius. It now forms part of the Colony of Seychelles, and was not included in the British Indian Ocean Territory in 1965.

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